



# Trekking with Type 1 Diabetes

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## Introduction

Individuals with type 1 diabetes (T1DM) are often less active than peers with other chronic diseases. Among children with T1DM, lower activity levels correlate with poorer fitness levels, worse glycemic control, and weight difficulty. In children with T1DM, increased physical activity lowers A1C by 0.3 to 0.5 points. Reducing sedentary time improved metabolic control in this population. Different forms of exercise have varying effects on glycemia. Continuous glucose monitors (CGM) allow for direct monitoring of glucose levels. Insulin pumps allow for a continuous flow of rapid acting insulin underneath the skin, and often integrate with CGM. Children participating in sports and exercise need to ensure their blood glucose levels maintain at a safe level. A combination of these technologies allows for this to be managed when hiking in Yellowstone or exploring the Grand Canyon.



Image 1: Medtronic 780G



Image 2: Tandem T-Slim Control IQ

## Results

After comparing the insulin pumps, the pump that resulted to be the most effective and efficient for backcountry hiking was the Medtronic 780G. The Medtronic 780G has the most basal increments, maximum basal rate, and a large insulin reservoir. The pump uses AA batteries that can last 1 week. The system uses a hybrid loop system and is compatible with the Medtronic Extended Infusion Set for a 7 day wear. The pump can link to caregiver phones to access the information, and the pump has an exercise setting to automatically change a person's glucose target, as exercise changes the demand requirement for the body. The pump is waterproof at 12 feet for 24 hours. The limitations include a complex menu and hard buttons. Normal AA batteries do not function well in the cold, but specific batteries such as Energizer Ultimate Lithium batteries last to -40 degrees Celsius as well as NiMH AA batteries. The Tandem T-Slim Control IQ is small and lightweight, but does not have a phone application and needs to be charged. While Omnipod does not require tubing, it does not directly link to CGM.

Table 1. Insulin Pump Comparison

	Medtronic 780G	Tandem T-Slim Control IQ	Omnipod 5	Beta Bionics ILET	Dana Diabecare ISS
Require Tubing?	Yes	Yes	No	Yes	Yes
Dimensions	3.78 l x 2.11 w x 0.96 d (in)	3.13 l x 2.0 w x 0.57 d (in)	2.05 l x 1.53 w x 0.57 d (in)	2.3 w x 3.58 h x 0.59 h (in)	3.5 w x 1.73 h x 0.75 h (in)
Basal Increment	0.025 units, 0.05 units, 0.1 unit	0.1 unit	0.05 units	Closed loop system determines need	0.1 unit
Max basal rate	0-35 units/hr	15 units/hr	30 units/hr	30 units/hr	16 units/hr
Max bolus	15 units	30 units	25 units	25 units	16 units
Capacity of reservoir	300 units	300 units	200 units	180 units	300 units
Battery Life	AA batteries	Rechargeable lithium-ion battery lasts about 7 days	Rechargeable lithium-ion battery	Rechargeable battery lasts 4-5 days	Single 3.6V battery lasts 2-3 months
Basal programming	3 basal patterns	6 patterns	12 patterns	N/A	N/A
CGM integration	Yes- Smartguard technology can only be used for patients requiring 8 to 250 units/24 hr	Yes- Control IQ and Basal IQ Technology; 10-100 units/24 hr	Yes- SmartAdjust technology	Yes	No
Limitations	* Hard physical buttons *Complex menu (requires learning curve)	*Buttons are small *Requires to be unlocked to make changes	*Does not have direct CGM integration *Requires a programmer to change settings	*Small reservoir *Rechargeable battery	*Requires medical professional to change settings *Few basal rate delivery options
Advantages	*Hybrid closed loop system *Meal Detection Technology *Compatible with Medtronic Extended infusion set (up to 7 day wear) *Connect to Carelink Connect app for caregivers to access *Exercise setting to change a person's glucose target *Corrects glucose levels	*Hybrid- closed loop system *Control IQ system prevents extreme glucose readings	*Hybrid closed loop system *Bolus calculator *Library of over 80,000 foods *Covered by many insurance companies	*No settings to manage *Insulin is monitored and given upon what is required *Share results with multiple people	*Closed loop system *Price is less than other insulin pumps *Low basal rate delivery *Lightweight and small in size
Water resistant	Waterproof for depths of 12 feet for 24 hours	Watertight to a depth of 3 feet for up to 30 minutes	Waterproof for depths 25 feet for 60 minutes	Water resistant up to 12 feet for 30 minutes	Waterproof
Effect of elevation above sea level	Interruption in insulin delivery occur at low atmospheric pressures (climbing above 10,150 feet)	Interruption in insulin delivery can occur at low atmospheric pressures (climbing above 10,000 feet or take off during air travel)	Interruption in insulin delivery occur at low atmospheric pressures (climbing above 10,000 feet or take off during air travel)	Unknown	Interruption atmospheric pressure below 500 mmHg or above 1060 mmHg
Integration with devices	Bluetooth with smartphones, CGMs, Apple Watches	No, control using touch screen. Can be used with CGMs.	Does not connect directly with CGM, but can use CGM data from app on phone with app on phone for Omnipod; insulin pump controlled with insulin-provided controller or phone with app	Bluetooth with smartphones and CGM	Bluetooth with app
Diabetes	Type 1 diabetes, ages 2 and older	Type 1 diabetes, ages 6 and older	Type 1 or Type 2 diabetes	Type 1 diabetes, ages 6 and older	Type 1 diabetes, ages 7 and up

## Discussion

Five insulin pumps were researched and evaluated for ease of use, physical size, battery life, and special features to help providers determine which insulin pump would be most effective, practical, and efficient for patients with type 1 diabetes. As providers, understanding the patient's goal is important in determining which insulin pump is most appropriate. For children going hiking or backpacking, the Medtronic 780G would be the most effective in monitoring blood glucose levels, as parents could monitor if not physically with the child. If a patient does not have a smartphone, the Tandem T-Slim Control IQ may be the best option, as the controls are on the pump itself. Knowing the advantages and limitations of these brands and aligning with the patient's needs will help guide a patient to the pump most suitable for them.

## Conclusions

As providers, understanding the patient's goal is important in determining which insulin pump is most appropriate. For children going hiking or backpacking, the Medtronic 780G would be the most effective in monitoring blood glucose levels, as parents could monitor if not physically with the child. If a patient does not have a smartphone, the Tandem T-Slim Control IQ may be the best option, as the controls are on the pump itself. Knowing the advantages and limitations of these brands and aligning with the patient's needs will help guide a patient to the pump most suitable for them.

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